MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. XXIII. *June* 12, 1863. No. 8.

C. B. VIGNOLES, Esq., Vice-President, in the Chair.

The Ven. Archdeacon Garbett, Chichester,
was balloted for and duly elected a Fellow of the Society.

On the Indications by Phenomena of Atmospheres to the Sun, Moon, and Planets. By Professor Challis.

As the Earth has an atmosphere, it is not unlikely that the other bodies of the solar system are similarly furnished, and the knowledge we have of our own atmosphere may reasonably be employed in inquiring whether the existence of other atmospheres of the same kind is indicated by phenomena. I propose, therefore, in this communication to discuss generally the possible effects, observable from a distant position, of an atmosphere constituted like the Earth's, with the view of ascertaining whether such effects have been actually observed.

The most notable effect of the Earth's atmosphere is the refraction of the rays of light which pass through it. In consequence of this refraction, the apparent magnitude of the Earth, as seen by a distant spectator, would be in some degree greater than the apparent magnitude of the globe deprived of its atmosphere, because the rays which pass from the periphery of the globe to the position of the spectator must have a curved course concave to the straight line joining that position and

the Earth's centre. It happens that we are able to calculate exactly the amount of the augmentation in the case of the Earth, independently of any law of variation of the density of the atmospheric strata. I am indebted to Professor Adams for pointing out to me that this inference may be very simply drawn from the construction given by Mr. Sang, in a "Note on the Method of Computing the Moon's Parallax," contained in vol. xv. p. 169, of the *Monthly Notices*. The ratio of EK to EL, which is the ratio of the refractive index for the lowest stratum of the atmosphere to that for the highest, becomes, for the case of a ray which just grazes the Earth's surface, the ratio of EK to EA. Supposing the spectator to be placed at the Moon, this ratio is that of the Moon's horizontal parallax augmented by refraction, to the horizontal parallax unaugmented. As the refractive index for the highest stratum may be taken to be unity, if μ be the refractive index for the lowest stratum, we thus find that the augmentation is equal to $(\mu - 1) \times$ the Moon's horizontal parallax. This quantity is almost exactly $1''$. A mountain five miles high, situated at the Earth's apparent border, would subtend at the Moon an angle of $4\frac{1}{2}''$, and its top would be somewhat less elevated by the refraction than the base, on account of being higher up in the atmosphere. Thus it appears that the atmospheric refraction would only produce the effect of a slight apparent depression of the mountain. These results show that any atmosphere the Moon can be supposed to have would neither augment her apparent diameter to a perceptible amount, nor alter the forms of the inequalities on the periphery.

There is, however, another effect of atmospheric refraction which might determine whether or not a lunar atmosphere exists. We know that, to a spectator on the Earth, the Sun or a star remains visible above the horizon, by the effect of refraction, when its actual direction falls below the horizon. The same thing would happen to a spectator at the Moon. By reason of the bending of the rays in their passage through the Earth's atmosphere, a star about to be occulted would be visible when its actual direction from the place of the spectator falls within the Earth's apparent periphery. In consequence of the rays by which it is seen being successively more and more bent by the refraction, the star will appear to retire before the Earth's limb, and will disappear suddenly when the rays just graze the Earth's surface. Analogous effects would be produced at a reappearance: the star will be first seen to emerge from the limb when its proper direction falls within the Earth's contour, and will then separate from the limb at an increasing rate till it escapes from the influence of the terrestrial refraction. It is evident that if the Earth's apparent diameter were calculated from the observed times of such disappearances and reappearances, without taking any account of the effect of refraction, the result would be much less than the true value.

These considerations show that if the Moon has an atmosphere constituted like the Earth's, her apparent diameter, as inferred from the calculation of occultations of stars and eclipses of the Sun, would be less than the diameter obtained by instrumental measurement, provided the atmosphere produced a sensible amount of refraction. A large number of occultations of stars and planets observed at the Cambridge Observatory, the results of which are exhibited in final equations involving corrections of the quantities assumed in the calculations, might be used for determining this point. It would, however, be necessary in each instance to correct the place of the Moon and that of the star or planet; and, after all, the determination of apparent diameter would be uncertain on account of the liability to error being much greater in observing occultations at bright limbs than in observing those at dark limbs. As far as I have gathered from the mean of a large number of equations, on the supposition that the only error to be corrected is that of the Moon's assumed semi-diameter, the result does not appear to confirm the hypothesis of an atmosphere. On the other hand, the Cambridge observations of the Solar Eclipse of March 15, 1858, reduced so as to correct the tabular differences of the R.A. and N.P.D. of the Sun and Moon, give a correction of the Moon's semi-diameter in the *Nautical Almanac* equal to $-2''{\cdot}96$; and Mr. Airy obtained from a discussion of the Cambridge observations of the Solar Eclipse of July 16, 1833, a like correction equal to $-4''{\cdot}21$. (See *Memoirs of the Royal Astronomical Society*, vol. viii. p. 133, and vol. xxvii. p. 60.)

In an eclipse of the Sun by the Earth, as seen from the Moon, the terrestrial refraction would cause solar rays to reach the Moon, which come from parts of the Sun's disk that are really behind the Earth. There will, consequently, be a condensation of light, so far as this cause operates, bordering the Earth's limb, but extending a very little distance from it, since the whole height of the terrestrial atmosphere, assuming it to be 60 miles, subtends only an angle of $52''$ at the Moon. This light will be much diminished in intensity by having to pass through the dense parts of the Earth's atmosphere, as is evident from the fact that the Sun's face, when near setting, loses so much brightness that it can be looked at with impunity with the naked eye. Also, the rays from this fringe, being divergent, will on that account fall with less intensity on the Moon. But the fringe will remain, and a narrow strip of the Sun's face be apparent long after the disk is geometrically behind the Earth; and the light will generally acquire a ruddy colour by passing, for the most part, through the vapours near the Earth's surface. The red appearance of the Moon's disk during a total lunar eclipse is, as is well known, accounted for in this manner. If we now inquire whether any analogous phenomena are presented in an eclipse of the

Sun by the Moon, we may at once pronounce, considering that if there be a lunar atmosphere, it must be of extreme rarity, that no effect would be at all likely to be discernible, except a slight condensation of solar light bordering the part of the Moon's periphery which crosses the Sun's disk. It is stated by Professor Stephen Alexander, in an account of observations of the total Solar Eclipse of July 18, 1860, published by the Superintendent of the United States Coast Survey, that himself and two other observers saw "a bright band bordering the edge of the Moon which was projected on the Sun's disk." (Appendix, No. 21, to Report for 1860.) It might be doubted from this description whether the band was on the Sun's disk or the Moon's. But, as one of the observers says that he saw "the Sun brighter along the border of the Moon," I conclude that the band was exterior to the Moon's edge. Professor Alexander further states that he first noticed the phenomenon in 1831, and had since, on various occasions, called the attention of others to it; also that "the bright band is unquestionably pictured in the copies of daguerreotypes of the eclipsed Sun." I have referred to these statements in the hope that in future eclipses of the Sun, partial or total, observers may have their attention directed to this appearance, which, as bearing on the question of a lunar atmosphere, is of no little interest.

In the case of an occultation of a star by the Earth, as seen from the Moon, if the strata of the atmosphere were transparent and undisturbed, and everywhere of the same density at the same height above the Earth's surface, the rays by which the star is last or first seen would coincide with rays from the apparent periphery of the Earth, and the star at disappearance or reappearance would, consequently, appear to be exactly on the periphery. But disturbances and variations such as we perceive actually to take place in our atmosphere would destroy this coincidence, and cause the disappearances and reappearances to occur at points separated, on one side or the other, from the Earth's limb. Circumstances of this very kind have been noticed in occultations of stars by the Moon, and would seem to admit of explanation by the hypothesis of a lunar atmosphere. But, although such phenomena, and that above mentioned of the bright band bordering the Moon in a solar eclipse, are reconcileable with the supposition of an atmosphere, they would hardly suffice to prove its existence. An ascertained excess of the Moon's diameter, as measured, above the diameter determined by occultations of stars and solar eclipses, would be a crucial fact, inasmuch as it does not appear that this fact could be accounted for on any other supposition than that of a lunar atmosphere.

I proceed now to consider another effect of atmospheric refraction; in noticing which, as far as I am aware, I have not been anticipated by any previous investigator. Hitherto it has been supposed that a ray from a star or other object may

pass *through* the atmosphere in a course which grazes, or is a tangent to, the interior globe. It is evident that in such a case the curvature of the path of the ray is *less* than the curvature of the surface of the globe. But it is conceivable that there may be such a relation between the gradation of density of the atmospheric strata, and the curvature of the globe, that this condition cannot be fulfilled. For instance, it is reasonable to suppose that this is the case in the Sun's atmosphere, when the vast magnitude of the globe is considered, and the usual equation $-k\,d\varrho = G\varrho\,dz$ is taken into account, which shows that the decrement $-d\varrho$ of density corresponding to a given increment dz of height varies conjointly as ϱ the density and G the Sun's gravity. It will, therefore, be worth while to inquire what optical effects will result under these circumstances.

A ray of light proceeding from a point on the surface of the globe, in a direction making an angle with the surface less than a certain limiting angle (α), will not pass out of the atmosphere, but will either reach a maximum distance and then return by a like path to the surface again, or will be reflected internally from the upper atmospheric surface, if the atmosphere be of finite density at its superior limit. Conversely, a ray entering the atmosphere from an external body could not impinge on the surface of the globe in a direction making with it an angle less than α. It seems necessary to suppose that an atmosphere has an upper boundary like that of an ocean, because, the density continually decreasing with the height, a point must at length be reached at which the upward repulsive force of an atmospheric stratum is just equal to the force of gravity, in which case there can be no downward repulsive force, and therefore no further extension of the atmosphere. Now the limiting angle α is the angle made with the surface of the globe by the course of a ray, which, after traversing the atmosphere and being refracted at the boundary, issues out in the direction of a tangent to the refracting surface. No ray which comes to the eye of a distant spectator can be inclined to the surface of the globe at a less angle than this.

From these considerations it follows (1) that rays proceeding from points of the Sun lying *beyond* the surface which contains all these limiting courses cannot reach the eye of a distant spectator; (2) that rays proceeding from points *within* that surface appear to come from points within the Sun's periphery; (3) that rays proceeding from any points *on* that surface eventually are tangential to the boundary of the atmosphere, and appear to come from the Sun's periphery. Consequently, if the boundary of the atmosphere be spherical, the periphery of the Sun will be an exact circle, notwithstanding any actual inequalities of the surface of the globe. Also, if we may suppose that any objects like clouds are suspended in the solar atmosphere, all the points lying on the limiting

courses will be brought by the refraction to the same level, that is, to the level of the upper boundary of the atmosphere. The augmentation of the Sun's apparent diameter as seen from a distant point will be just equal to the apparent height of the atmosphere.

The foregoing theory fully explains why the contour of the Sun is generally observed to be entirely free from inequalities. This fact is the more remarkable because the unevenness of the Sun's surface, as indicated by the mottled appearance spread over its whole extent, with the occasional occurrence of deep depressions (the spots), surrounded generally by lofty ridges (the faculæ), gives reason to expect that inequalities would be perceptible on the periphery. I am aware that Mr. Dawes has recorded the observation on Oct. 22, 1859, of a phenomenon, which he describes as "a bright streak, which formed the very edge, projecting irregularly beyond the circular contour of the edge." (*Monthly Notices*, vol. xx. p. 56.) This observation, which, as being made by so experienced an observer, must be accepted as trustworthy, by proving the possibility of seeing inequalities, provokes the enquiry, Why are they not more generally seen? The above theory accounts for their not being visible under ordinary circumstances, and at the same time it is possible that the solar atmosphere may be liable, under abnormal conditions, to disturbances and changes of level sufficient to account for the phenomenon Mr. Dawes witnessed. Besides this instance of inequality of contour I am acquainted with only that which was observed on Aug. 4, 1862, by Mr. Howlett, who states that "he plainly perceived a small notch in the Sun's margin, which struck him as not being caused so much by any deficiency in the circular limb of the Sun itself, but rather by reason of abnormally heaped up masses of the contiguous photosphere." (*Monthly Notices*, vol. xxiii. p. 113.) This phenomenon would thus seem to be similar to that seen by Mr. Dawes, and might be due to the same kind of disturbance. In both instances the details of the appearances presented by the spots and faculæ are of an unusual character.

With reference to the second instance, I beg to state that on July 26, at 2^h P.M., I saw with the Northumberland Telescope of the Cambridge Observatory the remarkable spot which is the subject of Mr. Howlett's communication. Mr. Todd, the Junior Assistant, who called my attention to it in the temporary absence of Professor Adams, took a sketch of it. The sketch is, consequently, intermediate to those of July 25 and 27, figured in pp. 110 and 111 of the *Monthly Notices*, above cited. The peculiarity of small nuclei situated on the edges of large patches of penumbra is exhibited, with great changes in the details, in this as in the other sketches. What chiefly struck me was a bridge stretching across the principal nucleus, remarkably bright, and not bounded by a penumbra.

I judged it to be brighter than the general surface of the Sun. Mr. Howlett, describing its appearance on July 25, calls it "a remarkable mass of brilliant photospheric matter," at which time it had not decidedly assumed the form of a bridge. This phenomenon and the peculiarity above mentioned, with the dislocated appearance of the adjacent patches of penumbra, seem to be indicative of an unusual amount of disturbance.

With respect to indications of the existence of atmospheres to the planets, little can be said relative to the effects of atmospheric refraction. From what was proved at the beginning of this communication, the apparent semidiameters will most probably not be sensibly increased if the refraction be of the first kind; and if of the second kind, the increase would be the angle which the whole height of the atmosphere subtends at the Earth, and would vary with distance according to the same law as the apparent semidiameter. Supposing the refraction of *Jupiter's* atmosphere to be of the first kind, a satellite would probably be eclipsed as soon as the atmosphere interferes with its visual direction, because the deviation and divergence which the rays undergo by incidence on the atmosphere, might at once render them invisible at the great distance of the Earth. If otherwise, the satellite would diminish in brightness before disappearing, and such diminution might be taken as evidence of the existence of an atmosphere. If the refraction were of the second kind, the satellite would disappear without diminution of brightness, just as if it had been eclipsed by an opaque body. The most direct physical evidence of a planet's atmosphere would be the constant recurrence of variable appearances on the disk known not to be due to rotation, it being hardly conceivable that such appearances can have any other origin than the suspension and motion of cloud-like substances in an atmosphere. Such phenomena are observable on the disks of *Jupiter* and *Saturn*, and, as would seem from recent observations, on that of *Mars*.

It remains to notice one other phenomenon indicative of an atmosphere: a distant spherical body, whether self-luminous or shining by reflected light, would, according to the law that the intensity of the radiation varies as the sine of the angle which the direction of emanation makes with the surface, appear equally bright at all points of the disk. But an atmosphere to the body, of considerable magnitude and constituted like the Earth's, would intercept more of the rays coming from the parts near the periphery than of those coming from near the centre of the disk, because the former would pass through a greater thickness of atmosphere. There would, in consequence, be a gradual diminution of brightness from the centre to the circumference. This phenomenon is, in fact, plainly discernible in a photographic picture of the Sun, or in an image received on a screen, and is so simply explained by the above considerations, that it almost justifies of itself the inference that

the Sun has an atmosphere. The effect would be produced whether the atmospheric refraction be of the first of the two kinds before mentioned, or the second, but would be less conspicuous in the latter case than in the other. With respect to *Jupiter*, also, I have frequently remarked, that the features of the disk appeared more distinct near the centre than towards the periphery; and on the occasion of the occultation of this planet on January 2, 1857, I made the note that when it emerged from the Moon's bright limb, it appeared "brighter at the central parts than towards the border, and had in consequence something of a pellucid appearance." (See *Monthly Notices*, vol. xvii. p. 138). These phenomena are readily explained by the supposition of an atmosphere.

Cambridge, April 13, 1863.

On an Eclipse of the Sun recorded in the Chinese Annals as having occurred at a very early Period of their History. By Mr. Williams, Assistant-Secretary.

A few weeks since Mr. Hind requested me to look into the annals of China, with a view of ascertaining the particulars of a very early Solar Eclipse, said to be recorded in their most ancient historical work, the *Shoo King*, a copy of which is in my possession. I accordingly undertook the task, and the information thus obtained appearing to be of considerable interest, I am induced to lay it before the Society, it being the earliest record known of a Solar Eclipse. I therefore will very briefly give the result of this investigation, explaining, at the same time, the process by which it has been obtained. It is to be remembered that it is the Chinese account only I now lay before you, leaving its corroboration or disproval to those more competent than myself to enter into that part of the subject.

In the 書經 *Shoo King*—the most ancient historical work of the Chinese—in the second section of that work, under the 夏 Hea Dynasty, it is related that, in the reign of 仲康, Chung Kang, the fourth Emperor of that Dynasty, an Eclipse of the Sun took place. The passage recording this Eclipse occurs incidentally in an account of the delinquency of 羲 He and 和 Ho, two important officers, who appear to have had the superintendence of the Imperial Astronomical Board, as it may be called, and who, giving themselves up to wine, neglected their duties, and consequently, failing in the prediction of the Eclipse in question, rendered themselves

liable to punishment for that offence. The prediction of an eclipse was a matter of very great importance in China, as certain religious ceremonies were required to be performed, both by the Emperor and the people on these occasions, of which it was necessary that due notice should be given, in order that the requisite preparations should be made.

The passage recording the Eclipse is as follows, beginning to the right and reading downwards :—

集 Tseih	朔 So	季 Ke
于 Yu	辰 Shin	秋 Tsew
房 Fang	弗 Foo	月 Yue

which may be rendered, "In the last month of the autumn, the first day of the moon, the heavenly bodies were not in agreement in Fang."

I have not hitherto been able to find, in the *Shoo King*, any more definite date assigned to this Eclipse; but in other historical works in my possession the following passage occurs in each, which supplies this deficiency :—

元 Yuen	夏 Hea	壬 Jin
歲 Suy.	仲 Chung	戌 Seuh
	康 Kang	

This passage requires some explanation to render the observations that follow intelligible. The first two characters (Jin Seuh) are the cyclical characters of the year in question; the next (Hea) is the name of the dynasty; the next two (Chung Kang) are the name of the Emperor; and the last two (Yuen Suy) express "the first year." This sentence, then, is to be rendered, "In the year Jin Seuh of the Cycle, the first year of Chung Kang of the Hea Dynasty." The account that immediately follows this passage does not directly relate to the subject of the Eclipse, and is followed by the before-mentioned words of the *Shoo King*, commencing with "Tsew," and with the character for nine before the word "Yue" (month), consequently reading, "In the autumn, the ninth month, the first day of the moon," &c.

The notes in each of these works explain this passage as relating to an Eclipse of the Sun. In two of them we have a

further explanation of some of the expressions employed. Thus "Shin," the fifth character, is said to signify the "Sun and Moon;" and it is intimated that these luminaries are described as not being in "harmonious agreement in the division Fang."

It must, however, be mentioned, that in the great collection of Chinese historians, in three hundred volumes, entitled *She ke*, "*Historical Annals*," the early part of which was compiled in the century before the Christian era, although the neglect of He and Ho and their subsequent punishment are mentioned, no account of the occurrence of an Eclipse is given.

We have then, in the passage just quoted, a positive date assigned to this Eclipse, viz. "Jin Seuh," a certain year of a cycle, and the ninth month of that year. It remains, then, to show how this date is to be expressed in our notation. The mode of effecting this is, when explained, exceedingly simple, and the following is the course to be pursued:—The Chinese regulate their chronology by periods or cycles of 60 years. The years of these cycles are indicated, not by numerals, but by certain characters called by them Kea Tsze. These they divide into two series, the one of ten, the other of twelve characters, and the name Kea Tsze is derived from the names of the first characters in these series. They are employed in the following manner:—Combining the first characters in each series, we obtain the appellation of the first year of the Cycle, Kea Tsze. The second characters are combined for the second year, and so on to the eleventh, when the first character of the shorter series combines with the eleventh of the longer; and at the thirteenth the third of the shorter series combines with the first of the longer for the appellation of that year. Thus it goes on until, in the sixtieth year, the two last characters combine to form 60, and are followed in the sixty-first year by Kea Tsze, as before, when a new cycle commences.

We are now prepared to investigate the date of this Eclipse, as given in the Chinese annals. Upon examination, the characters at the commencement of the passage quoted (Jin Seuh) are found to be those answering to the fifty-ninth year of the cycle; and this particular cycle is considered by the Chinese to be the eighth of their series. Now it is reckoned that the seventy-fifth cycle commenced in the year 1804 of our era: consequently, seventy-four cycles were completed in 1803. Hence $74 \times 60 = 4440$ will give the number of years elapsed since the commencement of this mode of reckoning to 1803. Subtracting from that number the years of the Christian era, 1803, we obtain 2637 B.C. for the first year of the first cycle. Now we gather from the text, that the first year of Chung Kang was the fifty-ninth year of the eighth cycle, and, consequently, that seven cycles and fifty-nine years would be completed in that year. Consequently, that year was $7 \times 60 + 59 = 479$ years from the commencement of the cyclical mode of reckoning. Subtracting this from 2637,

we obtain 2158 B.C. as the date of the accession of Chung Kang; and as the eclipse occurred in the autumn of the same year, it must also be the date of that phenomenon.

We have now to consider the part of the heavens mentioned as the place where the eclipse took place; and here I may be allowed a few words in explanation of the mode in which the Chinese astronomers arrange the stars.

The visible heavens are divided by them into thirty-one parts. Three of these, called "yuen," are of considerable size. The first, called "Tsze wei yuen," comprises the Circumpolar stars, and may be considered as including those that never set in China. The second, named "Tai wei yuen," is bounded to the south by stars in *Virgo* and *Leo*, and includes to the north *Coma Berenices*, *Canes Venatici*, and some stars in *Ursa Major*. The third, "Teen she yuen," is bounded by stars in *Serpens* and *Hercules:* thus including the greater portion of *Ophiuchus*, the constellation *Hercules*, and other stars to the north.

The remaining twenty-eight divisions, called "Suh," of which *Fang* is one, may be considered as representing the lunar houses. They, however, are very irregular in extent, both from east to west and from north to south. Thus, while the smallest is less than one degree from east to west, the largest extends thirty-one degrees, and of the rest no two are alike in dimensions. In like manner, while one extends north and south from *Perseus* to *Canopus*, another consists merely of a few small stars in the head of *Orion*. Each of these twenty-eight divisions is determined by a certain group of stars having the name of the division, but frequently forming a very small portion of it, the name being common to the whole division, which may include various other asterisms wholly unconnected with the group thus named.

Thus, in the most extensive division Tsing, the group of stars so called consists of γ, ε, λ, μ, and other stars in *Gemini*, but the whole division extends 31° from east to west, and from *Perseus* in the north to *Canopus* in the south. It is necessary, in speculating on any phenomenon recorded in the Chinese books, to keep these circumstances in view, as an appearance described in these records as having occurred in Tsing, may be referred to any part of that division, and thus, without more definite information, its probable place cannot be identified with any degree of certainty.

The division Fang, in which this Eclipse is said to have occurred, is a very small one, being only about five degrees from east to west, and of but little extent from north to south. Its determining group consists of the stars β, δ, π, and ϱ in *Scorpio*. It includes also a few small stars in *Libra* and *Ophiuchus* to the north, and in *Lupus* to the south. This, then, is the part of the heavens in which the Eclipse occurred; and, as it is a Solar Eclipse that is recorded, I presume there would be but little

difficulty in ascertaining the exact place of the Sun at the time mentioned.

The result then of this investigation, as far as I have carried it, is, that a Solar Eclipse is recorded in the most ancient Chinese historical work extant, as having occurred in the reign of Chung Kang, of the Hea dynasty, which Eclipse is more circumstantially mentioned by subsequent historians as having taken place in the first year of that Emperor, being the fifty-ninth year of the eighth cycle. That according to their mode of reckoning, the date of this Eclipse, expressed in our numbers, is 2158 B.C. and that it occurred in the ninth month of that year, in their division Fang, that asterism being part of our constellation *Scorpio*.

I have thus given the account of this Eclipse, simply as it occurs in Chinese historical works of reputation. There are, however, discrepancies in the year of the founding of the Hea dynasty, both in Chinese and European authorities, which may require attention. Leaving out one Chinese author, whose difference is upwards of 200 years, I find the first year of Yu, the founder of that dynasty, was according to one authority 2206, and according to the historians I have followed in this investigation 2204 B.C. According to what may be called European authorities, we have in Du Halde 2208, and in Gaubil 2205, as the date of that event. We have here then a difference of about four years, within which limits, I presume, should a Solar Eclipse be found to have occurred, satisfying the conditions as to time and place, it may reasonably be considered as that recorded in the curious and ancient book from which the preceding account has been taken.

I have also thought it necessary to give important passages in the original characters, knowing from experience the extreme difficulty of ascertaining with any degree of certainty the actual words intended to be employed, when their equivalent sounds are expressed in European letters only.* Whether a Solar Eclipse, visible in China, actually occurred at or near the time mentioned must be left for others to determine; and I can only say in conclusion, that should such be found to have been the case, it will afford a strong evidence of the general veracity of the early annals of that very ancient and interesting people.

On the Value of the Solar Parallax deduced from the Lunar Tables. By P. A. Hansen.

In the *Monthly Notices*, vol. xxiii. No. 7, Mr. E. J. Stone discusses different values of the co-efficient of the Parallactic

* For the loan of the Chinese type employed in this paper, the Society is indebted to Mr. Watts, Printer, of Crown Court, Temple Bar.

Equation of the Moon, and closes his note with the following words:—"It would be a point of interest to determine whether Professor Hansen's theory would bear any considerable increase in the mean Solar Parallax." I fulfil this desire with all the more pleasure, since the determination of the Solar Parallax from my Lunar Tables may be obtained by means of data which have been already published.

On page 177 of the *Darlegung der theoretischen Berechnung der in den Mondtafeln angewandten Störungen*, it will be found, that in my calculation of perturbations for the ratio of the major semi-axis of the orbits of the Earth and Moon, I have adopted the following value:—

$$\log \frac{a}{a'} = 74034757$$

which gives, for the co-efficient of the Parallactic Equation 121″·368 (Lunar Tables, p. 8). By comparison with observations, however, it results that all inequalities, theoretically calculated with the above value of $\frac{a}{a'}$, must be multiplied by the factor 1·03573 in order to conform to the observations. When, therefore, the above-mentioned co-efficient is multiplied by this factor, it gives 125″·70, which coincides very nearly with the value which Mr. Airy has obtained by the Altazimuth.

Further, in the Lunar Tables (p. 4), the constant of the Parallax of the Moon is given as = 56′ 59″·57. This being multiplied by the above value $\frac{a}{a'}$, we have 8″·66 for the Solar parallax, which has been adopted as the basis of the theoretical calculations. This, again, being multiplied by the above factor 1·03573, the Solar Parallax, determined by the elaboration of the Lunar Tables, becomes 8″·97. This value coincides very nearly with that which has been determined by the last opposition of *Mars*.

On the Companions of Sirius. By M. Goldschmidt.

(*Extract from a Letter to Admiral Manners, Secretary of the Royal Astronomical Society.*)

I have seen with satisfaction the insertion of my letter from M. l'Abbé Moigno's journal, *Les Mondes*, in your *Monthly Notices*, No. 5, vol. xxiii. I hope that *Sirius* will be observed next autumn by astronomers provided with large telescopes, to verify the minute stars I saw in its following vicinity. As long as *Sirius* was high enough above the horizon, I could see them; but afterwards I perceived only mere glimpses of light,

without being able to distinguish the position of the stars. On the top of the wood-cut in the *Monthly Notices*, No. 5, is written "*Position des Satellites :*" these words are not mine, for I cannot believe that they are all satellites. In the possibility that some of these luminous points could perhaps be the result of optical illusion or sickness of my eyes, I tried the same kind of observation (by passages) with some brilliant stars, like *Altair* and *Antares*, but I could see nothing like that I perceived on *Sirius ;* and so, having done all that is in my power, with an object-glass of only 4 inches (English measure) or 46 lines, to snatch such minute light points, I leave it to more skilful astronomers to do the rest; for a powerful telescope with clock-work and the star hidden behind a large plate would show this wondrous system. The distance of the star D I tried to measure on the moment of its discovery, and it might be distant east from *Sirius* $3^{s}{\cdot}60$ or $3^{s}{\cdot}80$ in Right Ascension. I found also another fainter and distant star (perhaps $10''$) in the vicinity, and on the east of the star D, which I announced in my first letter to Mr. Peters, on the 8th of March. On writing this, I received the news of Rev. Mr. Dawes' observation of the star D. It is, indeed, the most conspicuous of all by its *distant position* ; but I think that the two nearest ones are more brilliant, and seem to be bodies of great importance relative to *Sirius*.

Paris, le 5 Juin, 1863.

On the Discordance between the Results for Zenith Distances obtained by direct Observation and those obtained by Observation by Reflexion from the Surface of Quicksilver. By G. B. Airy, Esq., Astronomer Royal. (Abstract.)

After explaining the manner in which the discordance in question is practically taken account of at the Greenwich Observatory, the author remarks that, in preparing for the formation of the new Seven-Year Greenwich Catalogue of Stars, it appeared to him desirable to examine carefully the results of the reductions (extending over a quarter of a century) which have been conducted on the principle described, with the view of ascertaining whether the Direct Observations ought to be used alone, or whether the Reflexion Observations ought to be used alone, or whether the mean of them ought to be used, as has been done in the Annual Reductions; and that the object of the Memoir is to give the result of this inquiry. It appears that neither the D observations nor the R observations can be adopted, without correction, as sufficiently accurate, but that the D observations corrected by $\frac{1}{2}$ (R — D), or still better by $\frac{3}{5}$ (R — D), give accordant values

of co-latitude, and may be received as perfectly accurate; and it is inferred that the correction $\frac{1}{2}$ (R — D) or $\frac{3}{5}$ (R — D) is a real correction, founded on some physical cause. There is no room for explanation from defects of the instruments. A suggestion is, however, offered as to the nature of the physical cause of R — D, viz. from a comparison of the results for three different periods, for which different shutter-openings were used in the observing-room, it appears to be probable that the origin of the discordance expressed by R — D lies in some conformation of the warmer and cooler strata of the atmosphere in the immediate neighbourhood of the Instrument. The concluding paragraphs of the Memoir are as follows:—

"It is to me a matter of great satisfaction to be assured that the enormous number of observations made at Greenwich from 1836 have been reduced on principles which are fundamentally correct, and which scarcely leave appreciable error. But I think that the investigation leads to inferences of a broader and still more important kind. It appears probable that no co-latitude of an Observatory, where direct observations alone are used, is certain to a quarter of a second, and no north polar distance of stars at 70° or 80° from the pole is certain to half a second. I know no method of removing this doubt but the introduction of reflexion observations of stars on both sides of the zenith.

"I ought not to close this paper without acknowledging that my first ideas of connecting the discordance of direct and reflexion observations with the circumstances of the observing room, were derived from a conversation with Mr. Faye, when I had the pleasure of seeing him at Greenwich, on the occasion of determining the difference of longitude between Paris and Greenwich in 1854. At the time of reading his valuable paper in the *Comptes Rendus*, 1850, September 16, there was no critical evidence as to the cause of the discordance; and even in 1854, when the observations as far as 1852 were thoroughly reduced, there was not a sufficient amount of evidence under the new circumstances of the Instrument to enable me to form a decided opinion. It is only with the accumulation of evidence in later years, exhibiting results so consistent among themselves, but so distinctly opposed to those of former years, that the possibility has presented itself of pronouncing with certainty on the general origin of the discordance, and on the way in which, astronomically, it ought to be treated."

Observations on the Planet Mars. By J. N. Lockyer, Esq. (Abstract.*)

The author mentions that during the opposition of last year, in spite of the generally very unfavourable state of the weather, he was able to make a series of sketches which embraced a complete rotation of the planet; and that the opposition of last year, occurring on the 5th October in heliocentric longitude 12°, afforded the opportunity, among other things, of fairly comparing the series with the one taken by MM. Beer and Mädler in 1830, when the opposition took place the 19th September, in heliocentric longitude 356°. As regards the permanency of the features, the general result is that the two series of drawings agree in a marvellous manner, the author's very much larger instrument revealing no main feature which was not foreshadowed in the earlier series, although, from the greater light of his own telescope, he was enabled to study the details in a more satisfactory manner. But, although the complete fixity of the main features of the planet seems to be thus ascertained beyond all doubt, there occur daily, nay hourly, changes of detail, and in the tones of the different parts of the planet, both light and dark—changes which, he doubts not, are caused by the transit of clouds over the different features.

The larger part of the Memoir consists of comments on the drawings, and the comparison of them with the earlier series.

Results of the Meridional Observations of Small Planets; Occultation of a Star by the Moon; and Phenomena of Jupiter's Satellites; observed at the Royal Observatory, Greenwich, in the months of April and May, 1863.

(*Communicated by the Astronomer Royal.*)

Astræa (5).

Mean Solar Time of Observation.		R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1863, April 1	9 9 5·8	9 47 59·70	73 14 55·73
2	9 5 17·8	9 48 7·59	73 14 3·28
7	8 46 45·0	9 49 14·56	73 12 21·02
18	8 8 28·3	9 54 13·62	73 25 28·52

* The Memoir, with the accompanying drawings, or a selection from them, will probably appear in the volume of *Memoirs*. The drawings were exhibited at the Meeting of the Society.— Ed.

Metis (9).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1863, May 13	13 20 27·4	16 45 37·84	111 51 40·16
21	12 41 16·0	16 37 52·48	111 52 27·18
22	12 36 18·6	16 36 50·80	111 52 21·44
23	12 31 20·8	16 35 48·75	111 52 14·02
25	12 21 23·4	16 33 42·78	111 51 57·23

Irene (14).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1863, April 7	9 21 44·7	10 24 19·96	64 43 7·77
13	8 58 11·5	10 24 22·20	65 12 29·61

Eunomia (15).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1863, April 7	12 25 40·0	13 28 45·53	117 34 4·92
20	11 22 43·5	13 16 53·86	116 35 0·70
23	11 8 17·2	13 14 14·79	116 17 42·81
30	10 34 58·1	13 8 26·15	115 33 51·84
May 4	10 16 14·2	13 5 25·34	115 7 10·54
7	10 2 20·5	13 3 19·10	114 46 44·39

Psyche (16).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	° ′ ″
1863, April 7	13 44 35·1	14 47 53·57	102 7 0·74
16	13 3 16·5	14 41 57·17	101 31 40·09
20	12 44 37·5	14 39 1·28	101 15 4·27
23	12 30 33·3	14 36 44·41	101 2 26·86
25	12 21 8·9	14 35 11·62	100 54 2·75
28	12 7 0·6	14 32 50·66	100 41 25·34
30	11 57 34·8	14 31 16·43	100 33 7·65
May 1	11 52 51·6	14 30 28·94	100 28 58·33
2	11 48 8·8	14 29 41·99	100 24 50·95
4	11 38 42·9	14 28 7·64	100 16 41·95
13	10 56 31·3	14 21 18·12	99 42 29·34
21	10 19 36·5	14 15 49·66	99 16 41·99
25	10 1 28·0	14 13 24·41	99 5 56·30
26	9 56 58·4	14 12 50·62	99 3 30·92

Bellona (28).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
	h m s	o ′ ″
1863, April 1	8 23 18·6	9 2 5·03	71 1 39·41

Harmonia (40).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	o ′ ″
1863, April 16	13 7 16·2	14 45 57·53	99 31 24·01
20	12 47 53·2	14 42 17·56	99 15 7·71
23	12 33 12·5	14 39 24·06	99 3 3·94
25	12 23 22·5	14 37 25·55	98 55 3·58
28	12 8 34·4	14 34 24·74	98 43 20·96
30	11 58 41·6	14 32 23·43	98 35 47·96
May 1	11 53 45·0	14 31 22·56	98 32 7·53
2	11 48 48·8	14 30 22·12	98 28 28·57
4	11 38 56·1	14 28 20·83	98 21 26·91
7	11 24 10·0	14 25 22·00	98 11 32·79
8	11 19 15·4	14 24 23·15	98 8 27·66
13	10 54 52·8	14 19 39·37	97 54 41·76
21	10 16 43·4	14 12 56·12	97 39 28·71
22	10 12 2·8	14 12 11·31	97 38 13·24
23	10 7 23·6	14 11 27·86	97 37 12·66
25	9 58 9·7	14 10 5·63	97 35 27·66
26	9 53 35·2	14 9 26·94	97 34 54·25
28	9 44 30·6	14 8 13·95	97 34 9·68

Diana (78).

Mean Solar Time of Observation.	R.A. from Observation.	N.P.D. from Observation.
	h m s	h m s	o ′ ″
1863, April 15	10 0 8·2	11 34 22·23	96 10 13·04

All the observations of N.P.D. have been corrected for Refraction and Parallax.

Occultation of a Star by the Moon.

Day of Observation.	Phenomenon.	Moon's Limb.	Mean Solar Time.	Observer.
1863.			h m s	
Apr. 26	$\varkappa$ Cancri, disapp.	Dark	9 44 24·0	C.
26	$\varkappa$ Cancri, reapp.	Bright	10 53 15·5	C.

Phenomena of Jupiter's Satellites.

Day of Observation. 1863.	Satellite.	Phenomenon.	Mean Solar Time. h m s	Observer.
April 1	II	Eclipse, disapp.	12 18 35·7	E.
20	III	Ingress, bisection	14 14 42·7	E.
26	II	Eclipse, reapp.	11 51 25·5	C.
28	I	,, reapp.	11 6 45·3	E.
May 1	III	,, reapp.	11 26 4·9	R.
8	III	Occ. disapp. last cont.	10 39 53·4	N.
,,	III	Occ. reapp. last cont.	13 1 37·6	R.
,,	III	Eclipse, disapp.	13 3 52·3	R.
21	I	,, reapp.	11 17 34·9	E.
26	III	Egress, last cont.	9 30 59·6	C.
28	II	Eclipse, reapp. (*a*)	11 37 10·5	J. C.

(*a*) Probably late, the planet being very faint from cloud.

The initials E., C., J. C., R., and N., are respectively those of Mr. Ellis, Mr. Criswick, Mr. Carpenter, Mr. Roberts, and Mr. Nash.

Fig. 1.

Plato Sunrise. Rev. W. R. Dawes, 1863, April 26^{d} 1^{h} ±. Degree of illumination 0·03.

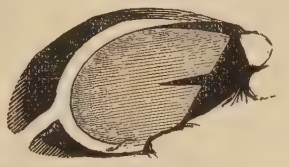


Fig. 2.

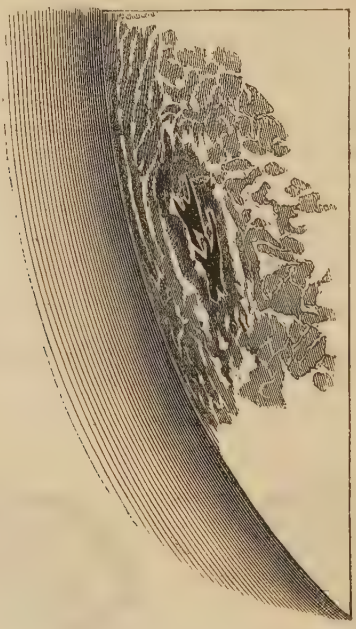
Plato Sunset. W. R. Birt, 1863, May 10^{d} 15^{h} 56^{m}. Degree of illumination 0·99.

Fig. 1 is intended to illustrate Mr. Dawes' paper on *Plato*, inserted in the last number of the *Monthly Notices*. The four crater spots on the floor are shown in the engraving. Fig. 2 exhibits the appearance of *Plato* at sunset, or more accurately within three hours of the sun setting in the western edge of *Plato*. Both sketches were taken during the same lunation, April and May, 1863.

Observation of a Solar Facula. By Capt. W. Noble.

While examining the Sun on the 24th of May, at 3^{h}, G.M.T., my attention was directed to a spot which was

just coming on to his following limb. Upon scrutinising the neighbourhood of this spot, I was at once attracted by the remarkable appearance presented by a facula situated between the spot referred to and the limb itself; an appearance depicted in the accompanying sketch. It was that



Part of the Sun's Limb, Sunday, May 24th, 1863. 3^h, G.M.T.

of a most extraordinary elevation above the general level of the Sun's apparent surface, the facula exhibiting quite a dark line on its following edge, and presenting a perfectly stereoscopic effect. My first impression was that this was an optical illusion, and that what I took for the shading on the following side of this enormous ridge of light was really a spot or macula excessively foreshortened. Upon looking at the Sun, however, when this supposititious spot *should* have arrived fairly on to his disk by his rotation, I found the neighbourhood a perfect blank, the spot, following which I had first observed the facula, being quite isolated. The drawing which I send was made, *ad naturam*, with a power of 154. Owing to the employment of a "Hodgson" eye-piece, a double reversal of the image has necessarily taken place. I have marked the facula *a*. The extreme length of the penumbra of the spot to the right of it, was as nearly as possible $0'{\cdot}8$ of arc, which will supply the scale to which the sketch was made.

Forest Lodge, Maresfield, Sussex,
June, 1863.

Eclipse of the Sun, May 17th, 1863.
By Capt. W. Noble.

The first indentation of the Moon upon the Sun's limb was observed about $9^h\ 24^m\ 37^s$ local sidereal time $= 5^h\ 44^m\ 55^s{\cdot}3$ local mean time. The Moon's limb was relatively smooth. The sky was very cloudy, and it was only at intervals that a distinct glimpse of the solar disk could be obtained. A slight break enabled the greatest phase to be observed. The Sun set densely obscured in a bank of clouds. Powers 42 and 74, approximate latitude and longitude 51° 0′ 58″ N., and $17^s{\cdot}5$ E.

Forest Lodge, Maresfield,
11th June, 1863.

Total Eclipse of the Moon, June 1st, 1863.
By Capt. W. Noble.

The singularly undefined character of the edge of the Earth's shadow, as viewed in the telescope, rendered anything like observations of Time hopeless. At the time of the middle of the eclipse, the lunar detail was well seen with a power of 42, save just in the centre of the shadow, where everything was obscured. I cannot remember ever to have seen such a nebulous density (if I may coin that expression) in any of the lunar eclipses which I have hitherto observed.

Forest Lodge, Maresfield,
11th June, 1863.

Occultation of κ Cancri by the Moon, 26th April, 1863.
By Capt. W. Noble.

The star disappeared instantaneously at $12^h\ 3^m\ 15^s{\cdot}1$ local sidereal time $= 9^h\ 45^m\ 41^s{\cdot}42$ local mean time. Power 115 adjusted on the star.

In the May number of the *Monthly Notices* is a paper by the Rev. W. R. Dawes on a very remarkable phenomenon observed by Mr. Copeland, near Manchester, upon the occasion of this occultation, viz., the extinction of three-fourths of the star's light just prior to its disappearance. I can only say that, as seen here, *κ Cancri* retained its intrinsic brightness up to the very instant of the Moon's covering it. I observed

with my Ross Equatoreal of 4·2 inches aperture, and although Mr. Copeland had the advantage of 0·8 inch in the diameter of his object-glass, my own instrument is one of such great and proved excellence, that I can only in his case, with great deference, suspect some optical illusion.

Observatory, Forest Lodge, Maresfield,
11th June, 1863.

Occultation of κ Cancri, 26th April, 1863. By J. Vertu, Esq.

I did not think it worth communicating to the Society the observation I made of the occultation of *κ Cancri* on the 26th of April last; but the communications of Messrs. Burr and Dawes, in the *Notices* for May, induce me to send this note.

Some time before the occultation, having ascertained the position of the star, I adjusted the focus to the Moon, and was not a little surprised to find the *lumière cendrée* so strong that the complete circle was sharply defined, and some features in the *dark* part discernible; so much so that I was only a few seconds wrong in the time of occultation by estimation. Now as such is, I think, seldom if ever the case in this country at that age of the Moon (8·8 days), and notwithstanding the isolated and exceptional cases mentioned by Gruithuisen and Kunowsky, it would be desirable to ascertain the cause of such an anomaly—whether it be produced by an exceptional condition of the atmosphere, by the Sun's light being reflected on our satellite by some particular spot of the Earth's surface, or otherwise. It cannot be attributed to the instrument; for, with the same telescope and eye-piece, I watched the new Moon again, but after the sixth day I could perceive no trace of the Earth's light.

As regards the occultation, which I watched with increased attention, the star, which I followed until in contact with the Moon's edge, disappeared *instantaneously*. It seems to me highly improbable that a star—even supposing it to be double—which under a power of 1000 has given a round disk, would produce a perceptible diminution of light: I should rather attribute such an impression to the excitement produced on the retina by an intense and protracted gaze at the object.

It is true that "*Visus est acerrimus sensuum;*" but, *à fortiori*, this adage holds good in scrutinising the star in the telescope.

The telescope used in this observation is a $3\frac{1}{2}$-inch, by Troughton and Sims; power, 84.

Nottingham, June 11, 1863.

Observations of Astræa (5), *and of Solar Eclipse, May* 17, 1863. By J. Hartnup, Esq.

Observations of *Astræa* (5), taken with the Equatoreal of the Liverpool Observatory:—

1863.	G.M.T. h m s	R.A. (5) h m s	N.P.D. (5) ° ′ ″	Star of Comparison.
March 3	8 50 43·0	9 57 16·96	75 14 49·7	Regulus.
,, 4	9 31 58·5	9 56 35·06	75 7 44·3	,,
,, ,,	9 41 56·2	9 56 34·79	75 7 41·3	,,
,, ,,	9 51 54·6	9 56 34·39	75 7 36·9	,,

The observations are corrected for refraction and parallax. The place of *Regulus* was taken from the *Nautical Almanac*.

End of Solar Eclipse, observed with the Equatoreal of the Liverpool Observatory:—

1863, May 17 $7^h\ 10^m\ 48^s{\cdot}77$ G.M.T.

End of Solar Eclipse, observed by John Joynson, Esq., at Waterloo, near Liverpool:—

Lat. 53° 28′ 24″ N.; long. 3° 1′ 44″ W.

1863, May 17 $7^h\ 10^m\ 46^s{\cdot}5$ G.M.T.

Observed with a Refractor of 3½-inches aperture and 50-inches focal length. The time was taken from a clock which is controlled by the Normal Clock at the Liverpool Observatory.

May 17, 1863.

Observation of Solar Eclipse, 1863, *May* 17. By Lord Wrottesley.

The end of the Solar Eclipse of the 17th of May was observed at my Observatory at Wrottesley, by my Assistant Mr. Hough, to take place at $7^h\ 2^m\ 17^s$, Wrottesley Mean Time. Telescope, the 11-foot Equatoreal; aperture, 7¾ inches.

The same phenomenon was observed by myself, with my 45-inch Achromatic and Baird Pocket Chronometer,* No. 2962, at $7^h\ 2^m\ 10^s$, Wrottesley Mean Time.

The error of the Transit-clock was obtained by the observation of the Transit of a Greenwich Star during the Eclipse.

* This is the instrument which I lent to Sir Leopold M'Clintock, and which accompanied him during his last Polar Expedition.

The chronometer was compared immediately after the termination.

The beginning was lost through clouds. It became clear a short time after the commencement, and then the cusps and the limb of the Moon were sharply defined, and afterwards the limb became very tremulous; it was also very much jagged, as viewed in the larger telescope, resembling the teeth of a saw.

Observations of Occultations of Stars by the Moon; of Eclipses of the Sun and the Moon; and of Eclipses of Jupiter's Satellites; made at the Radcliffe Observatory, Oxford. Communicated by the Rev. R. Main.

Occultations of Stars by the Moon.

Day. 1863.	Star.	Phenomenon.	Observer.	Instrument.	Oxford M.T. h m s
Jan. 27	δ Arietis	Disap.	M.	Heliometer	5 3 52·7
	,,	,,	Q.	10-ft. telescope	5 3 53·5
	δ Arietis	Reap.	M.	Heliometer	6 21 6·2
Mar. 2	α Cancri	Disap.	L.	10-ft. telescope	11 42 12·6
April 29	e Leonis	Disap.	L.	,,	10 20 41·6
	e Leonis	Reap.	L.	,,	11 21 43·2

The initials M., Q., and L., are those of Mr. Main, Mr. Quirling, and Mr. Lucas.

Eclipse of the Sun, 1863, May 17.

Clouds prevented the beginning of the eclipse from being accurately observed; the time noted when they had cleared away being several seconds too late.

The end was, however, well seen by Mr. Lucas with the 46-inch achromatic telescope mounted on the leads of the Observatory outside the town.

The observed Oxford Mean Solar Time of the last contact was $7^h\ 6^m\ 32^s{\cdot}4$.

Eclipse of the Moon, 1863, June 1.

Mr. Lucas observed the beginning and ending of this eclipse with the 10-feet telescope, near the Heliometer Dome.

The Oxford Mean Solar Times are as follow: —

		h m s
First contact with the shadow	...	9 41 36
Beginning of total phase	...	10 46 40
Last contact with the shadow	...	13 0 57

Eclipses of Jupiter's Satellites.

Observed by Mr. Main with the telescope of the Heliometer: —

1863.		h	m	s	
April 1	Disappearance of 2d Satellite at	12	14	18·5	Oxford M.T.
28	Reappearance of 1st Satellite at	11	1	41·0	,,

M. Foucault's Apparatus for producing Uniform Motion.

(*Communicated by Lieut.-Col. R. Strange.*)

On a recent visit to Paris, M. Foucault was good enough to show me the new clock-work, just completed by the firm of Secretan, intended to drive the Great Equatoreal of the Paris Observatory.

M. Foucault has for some time been occupied with this subject, and has at length arrived at results with which he is himself perfectly satisfied, and which are also considered equally satisfactory by the authorities at the Observatory — the motion controlled by this apparatus being sensibly uniform under all possible changes in the motive force, and variations of friction and resistance.

I myself witnessed the following experiment:—The clock-work being detached from the Equatoreal (to which it had not yet been finally fitted), the full weight (about 58 lbs.) was applied ; and the instrument being adjusted for rate, the revolving index was timed by a chronometer for about half an hour, during which period no sensible variation of rate of revolution could be detected. Half the driving weight was then removed without stopping or in any way readjusting the instrument, and the revolution of the index was again carefully observed, but no variation of the smallest perceptible fraction of a second could be detected.

M. Foucault assured me that the instrument had been subjected to far more severe and protracted trials than the above, and with the same results; and he affirms that, for all practical purposes, the problem of obtaining uniformity of rotation under considerable changes of resistance is absolutely solved.

I shall not attempt to describe from memory a machine of which a full account will shortly be published by its distinguished contriver, by whom this important invention has been patented in France and England. My object in mentioning the subject is to induce those who are either engaged in the

same research, or who propose ordering any contrivance of this kind, to pause until M. Foucault's arrangement is made known.

I should add, that I have M. Foucault's permission to make the above communication to the Royal Astronomical Society.

London, June, 1863.

Ephemeris of Winnecke's Comet of Short Period, about the Time of Perihelion Passage, 1863. By J. R. Hind, Esq.

(*From Dr. Seeling's Elements, Ast. Nach. No.* 1319.)

Greenwich Mean Midnight.	R.A.		Decl.		Log. Dist. from Earth.		Log. Dist. from Sun.	
1863.	h m	m	° ′	° ′				
Nov. 2	15 9·1	+ 19·7	−13 23	− 1 42	0·2569	− 77	9·9265	− 131
6	15 28·8	20·7	15 5	1 38	0·2492	72	9·9134	111
10	15 49·5	21·6	16 43	1 34	0·2420	66	9·9023	85
14	16 11·1	22·5	18 17	1 27	0·2354	58	9·8938	56
18	16 33·6	23·3	19 44	1 18	0·2296	49	9·8882	− 22
22	16 56·9	23·8	21 2	1 7	0·2247	39	9·8860	+ 11
26	17 20·7	24·3	22 9	0 55	0·2208	28	9·8871	45
30	17 45·0	24·7	23 4	0 42	0·2180	17	9·8916	75
Dec. 4	18 9·7	24·8	23 46	0 26	0·2163	− 4	9·8991	103
8	18 34·5	24·7	24 12	−0 12	0·2159	+ 10	9·9094	125
12	18 59·2	24·3	24 24	+0 3	0·2169	23	9·9219	142
16	19 23·5	23·8	24 21	0 17	0·2192	37	9·9361	155
20	19 47·3	23·1	24 4	0 30	0·2229	49	9·9516	164
24	20 10·4	22·2	23 34	0 41	0·2278	61	9·9680	170
28	20 32·6	21·3	22 53	0 50	0·2339	72	9·9850	172
1864.								
Jan. 1	20 53·9	20·4	22 3	0 59	0·2411	81	0·0022	172
5	21 14·3	19·3	21 4	1 5	0·2492	90	0·0194	170
9	21 33·6	18·3	19 59	1 10	0·2582	97	0·0364	168
13	21 51·9	17·4	18 49	1 13	0·2679	102	0·0532	164
17	22 9·3	16·5	17 36	1 16	0·2781	107	0·0696	160
21	22 25·8	15·6	16 20	1 16	0·2888	110	0·0856	156
25	22 41·4	14·8	15 4	1 17	0·2998	111	0·1012	151
29	22 56·2	14·1	13 47	1 16	0·3109	113	0·1163	146
Feb. 2	23 10·3	13·3	12 31	1 16	0·3222	114	0·1309	141
6	23 23·6	12·7	11 15	1 15	0·3336	113	0·1450	137
10	23 36·3	+ 12·2	10 0	+1 12	0·3449	+ 112	0·1587	+ 132
14	23 48·5		− 8 48		0·3561		0·1719	

By Dr. Seeling's elements (neglecting perturbations, which, during the present revolution, are likely to be small) the Comet should arrive at perihelion on Nov. 23·178 Mean Time at Greenwich.

Nautical Almanac Office,
1863, *July* 1.

A note on the Eclipse of the Moon on June 1st, as seen at Exeter, accompanied by three drawings, which were exhibited at the Meeting, was received from Henry S. Ellis, Esq.

A note was also received from Mr. Thomas Petty, mentioning his observation on the morning of April 27 of a small but bright Comet, being in fact Comet III., 1863, see *Monthly Notice*, No. 7, pp. 226 and 227.

Corrections to the Translation of Prof. Wolf's Letter, Monthly Notices, May 8, 1863, *No.* 7.

(*Communicated by the Astronomer Royal.*)

Page 208.—The translation from the German is, perhaps a little too literal; and, to remove obscurity, the following modification is desirable:—

Lines 6 and 7, *inclose* in brackets ( ) the clause beginning with "not to enter," and ending with "in No. 13."

Lines 20, 21, and 22, *inclose* in brackets ( ) the clause beginning "when occupying myself," and ending "η (*Argo*) Navis."

Page 228.—Line 20 from the bottom, *for* star, *read* object.

Instruments for Sale.

Astronomical Telescope and Sidereal Clock.—The Telescope is by Tully, 5 ft. 6 in. focal length, 4-in. field, with three common and four astronomical powers, from 60 to 270; rack, vertical and horizontal movements, with Vernier scale to each; mounts on a strong mahogany stand, on a patent equatoreal block; main tube screws in midships, and packs up in a mahogany case, with lamp and illuminating reflector. The Clock by Barraud. Both formerly the property of the celebrated Astronomer, Baily.—Apply to J. Stebbing, Esq., F.R.A.S., Southampton.

CONTENTS.

	Page
Fellow elected	231
On the Indications by Phenomena of Atmospheres to the Sun, Moon, and Planets, by Prof. Challis	ib.
On an Eclipse of the Sun recorded in the Chinese Annals as having occurred at a very early Period of their History, by Mr. Williams, Assistant-Secretary	238
On the Value of the Solar Parallax deduced from the Lunar Tables, by Prof. Hansen	242
On the Companions of *Sirius*, by M. Goldschmidt	243
On the Discordance between the Results for the Zenith Distances obtained by Direct Observation and those obtained by Observation by Reflexion from the Surface of Quicksilver, by the Astronomer Royal. (Abstract.)	244
Observations on the Planet *Mars*, by Mr. Lockyer. (Abstract.) ...	246
Results of the Meridional Observations of Small Planets; Occultation of a Star by the Moon; and Phenomena of *Jupiter's* Satellites; observed at the Royal Observatory, Greenwich, in the Months of April and May, 1863, by the Astronomer Royal	ib.
Illustrations to Mr. Dawes's paper on *Plato* in last Number of *Notices*	249
Observation of a Solar Facula, by Capt. Noble	ib.
Eclipse of the Sun, May 17th, 1863, by Capt. Noble	251
Total Eclipse of the Moon, June 1st, 1863, by Capt. Noble	ib.
Occultation of *κ Cancri* by the Moon, 26th April, 1863, by Capt. Noble	ib.
Same Occultation, by Mr. Vertu	252
Observations of *Astræa* (5), and of Solar Eclipse, May 17, 1863, by Mr. Hartnup	253
Observation of Solar Eclipse, May 17, 1863, by Lord Wrottesley ...	ib.
Observations of Occultations of Stars by the Moon; of Eclipses of the Sun and the Moon; and of Eclipses of *Jupiter's* Satellites; made at the Radcliffe Observatory, Oxford, communicated by the Rev. R. Main	254
M. Foucault's Apparatus for producing Uniform Motion	255
Ephemeris of Winnecke's Comet of Short Period, about the Time of Perihelion Passage, 1863, by Mr. Hind	256
Miscellaneous	257

Printed by STRANGEWAYS and WALDEN, Castle St. Leicester Sq. and Published at the Apartments of the Society, July 16, 1863.